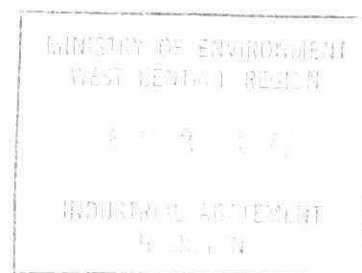


May 1977 C.E. DUNCAN

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CHLORINATED HYDROCARBON RESIDUES FROM SELECTED SITES ON LAKES ONTARIO, ERIE AND ST. CLAIR 1975

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Ontario

Ministry
of the
Environment

The Honourable
George A. Kerr, Q.C.,
Minister

Everett Biggs,
Deputy Minister

CHLORINATED HYDROCARBON RESIDUES FROM

SELECTED SITES ON LAKES

ONTARIO, ERIE AND ST. CLAIR

1975

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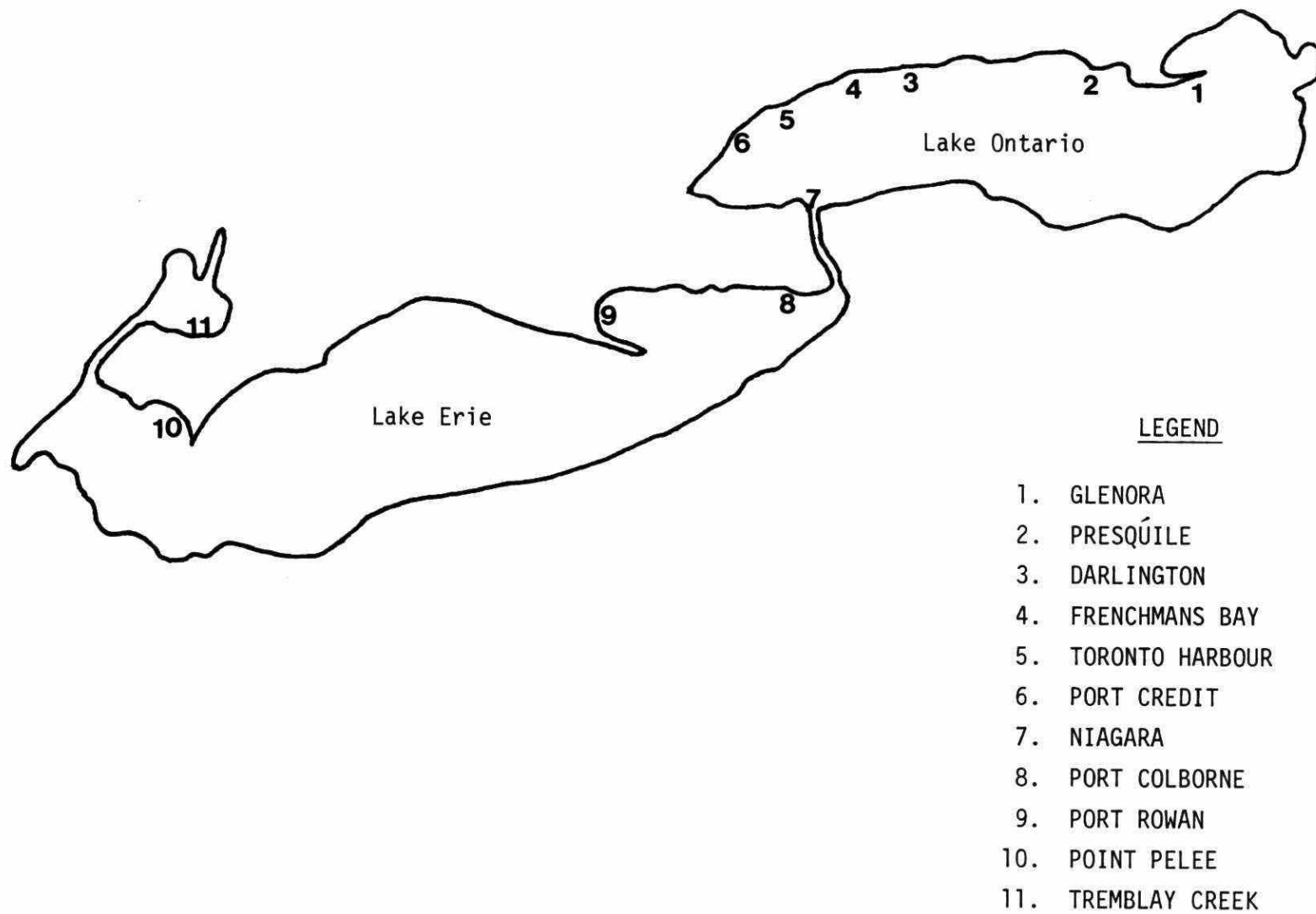
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Fig. 1. Locations of Sampling Sites on
Lakes Ontario, Erie and St. Clair



ABSTRACT

Samples of spottail shiners (Notropis hudsonius), sediments and lakewaters were collected at eleven sampling locations on Lakes Ontario, Erie and St. Clair during the fall of 1975 and analyzed for chlorinated hydrocarbon residues. All fish samples contained PCB and DDT residues. Mean PCB concentrations for young-of-the-year spottail shiners ranged from 0.06 $\mu\text{g/g}$ - 0.84 $\mu\text{g/g}$ (ppm) wet weight, and 2.9 $\mu\text{g/g}$ - 46.7 $\mu\text{g/g}$ lipid weight. Corresponding total DDT residues ranged from 0.03 $\mu\text{g/g}$ - 0.24 $\mu\text{g/g}$ and 1.4 $\mu\text{g/g}$ - 10.4 $\mu\text{g/g}$. Mean PCB concentrations in older fish from Toronto Harbour and Port Credit ranged from 1.98 $\mu\text{g/g}$ - 3.85 $\mu\text{g/g}$ wet weight, and 29.1 $\mu\text{g/g}$ - 52.7 $\mu\text{g/g}$ lipid weight; total DDT residues ranged from 0.22 $\mu\text{g/g}$ - 0.44 $\mu\text{g/g}$ wet weight and 3.2 $\mu\text{g/g}$ - 6.5 $\mu\text{g/g}$ lipid weight. Heptachlor epoxide, dieldrin, endrin and chlordane residues were found in some of the fish.

Of all sediment samples analyzed, 50% contained PCB and 90% DDT residues. Mean PCB residues in the sandy sediments ranged from non-detectable to 57 ng/g (ppb) levels, whereas residues in the more organic sediments ranged from non-detectable to 569 ng/g. Mean total DDT residues ranged from 2 ng/g - 15 ng/g in the sandy sediments, and 7 ng/g - 88 ng/g in the more organic sediments.

Within a detection limit of 0.01 $\mu\text{g/l}$, PCB residues were not found in any of the lakewater samples.

Rainwater collections from four locations on Lake Ontario and one on Lake St. Clair contained no detectable PCB residues.

Effluent samples from twenty-one municipal sewage treatment centres had PCB residue concentrations ranging from 0.03 $\mu\text{g/l}$ - 0.57 $\mu\text{g/l}$.

Preliminary analyses of industrial effluents from automotive and electrical equipment manufacturers revealed PCB residues ranging from 0.15 $\mu\text{g/l}$ - 3.20 $\mu\text{g/l}$.

INTRODUCTION

The widespread nature of chlorinated hydrocarbon contamination in the Great Lakes region has been documented by numerous studies (Veith 1971; Carr et al 1972; Kelso and Frank 1974; Reinert et al 1974; Hesse 1975; Parejko 1975). These investigations have shown that contaminant residue concentrations vary widely with fish species, size, life stages, locality and season of capture. A number of consumer orientated studies have established body burden levels for a variety of fish species from the Great Lakes, however, few have attempted to establish representative sample sizes for fish of similar age groups. While the above approach may be useful for detection of harmful contaminant levels in commercially exploitable fish species, the results have limited value for trend evaluations and monitoring purposes.

This study attempted to utilize a common forage species, the spottail shiner (Notropis hudsonius) of a uniform age and size to obtain chlorinated hydrocarbon data for eleven in-shore sampling stations from lakes Ontario, Erie and St. Clair. It was felt that the young-of-the-year spottails would provide the best age group for detecting recent contamination and, due to their limited home range, would facilitate localized contamination assessment and potential point-source identification.

In addition to residue determinations in the biota, a preliminary investigation was undertaken to determine PCB residue levels in municipal sewage effluents, rainwater and selected industrial wastes.

METHODS AND MATERIALS

Fish, sediments and lakewater were collected at eleven near-shore sampling stations from lakes Ontario, Erie and St. Clair (Figure 1).

FISH

A bag seine 20 meters long, with a 0.6 cm mesh size was used to capture fish. Fish were seined at 1 to 2 meter depths, and all collections were completed within a three week period. Individual fish were measured, wrapped in hexane-washed aluminum foil and frozen in the field. Fish

samples were stored at -20°C until processing for chemical analyses. PCB, HCB, BHC, lindane, heptachlor, aldrin, thiodan, dieldrin, endrin, chlordane and DDT residue level determinations were done on whole fish homogenates, each sample consisting of five, ten fish composites.

Sediments

Lake sediment samples were obtained by a 15 x 15 x 15 cm Eckman dredge. Two sub-samples were taken from each grab sample by removing the uppermost 3 cm layer of the sediment. While one portion of the sample was analyzed for pesticide and PCB content, the other was utilized for organic content determinations. Sediment samples were collected in pre-cleaned glass jars with aluminum foil lined lids, and frozen in the field. All samples were stored at -20°C until processing for chemical analyses. Sediments were collected at various water depths, over an area approximately 0.6 km², superimposed on the fish collection site. Actual sampling sites were chosen randomly. Twelve sediment samples were collected from each sampling area with the exception of Glenora, Presqu'île and Port Rowan sites, where only six samples were obtained.

Lakewater

Six sub-surface water samples were obtained from each sampling site, the collection points being closely associated with the sediment collection area. Water samples were collected in pre-cleaned 500 ml glass bottles, preserved with 40 mls of methylene chloride and cooled during transport.

Rainwater

Rainwater samples were collected on four sites on Lake Ontario and one site on Lake St. Clair during the fall of 1975 (Table 6). Each sample submitted for PCB residue analyses consisted of approximately 400 mls of rainwater, preserved with 40 mls of methylene chloride. Galvanized sheet metal collecting trays with a 0.5 m² surface area were used for all collections.

Industrial Wastes

A preliminary investigation of industrial effluent samples from an automotive and an electrical equipment manufacturer was undertaken in the fall of 1975. The companies sampled were General Motors Limited and Ferranti Packard Limited, both in St. Catharines, Ontario. A single grab sample of the final effluent was obtained from each of the processes, and samples were cooled during transport.

Municipal Sewage Effluent

Effluent samples from twenty-one municipal sewage treatment centres along the Lower Great Lakes were collected during the summer of 1975. Two grab samples of the treated effluent were taken at each of the centres. Samples consisted of about 500 mls of the effluent, and were preserved with 40 mls of methylene chloride.

Analytical Techniques for the Determination of PCB's and Organochlorine Pesticides

Extraction

Water

Unfiltered samples of rain, surface waters and effluents were extracted in their original containers with methylene chloride. The extracts were dried, evaporated to near dryness and made up in 1 ml of hexane for clean-up.

Sediment

An aliquot of the well-mixed sample, corresponding to 10 g dry weight was extracted with acetone using a Branson sonifier probe (350 watts). The filtered extracts were added to water and partitioned into hexane. The hexane extracts were dried, concentrated and made up to 100 ml. A suitable aliquot was concentrated to 1 ml for clean-up.

Fish

A 10 g aliquot of homogenized whole minnows was dried by mixing with sand and magnesium sulphate, then ground to a fine powder for Soxhlet extraction with hexane. The extract was made up to 100 ml and a 10 ml aliquot was concentrated to 1 ml for clean-up.

Florisil Clean-Up

Florisil, 100-200 mesh, activated at 130°C., was cooled for 5-20 minutes, depending on the ambient humidity. A glass column was packed with Florisil to a settled height of 20 cm and the sample was applied in 1 ml of benzene-free hexane. The column was developed by the dropwise addition of hexane (benzene-free) and eluted successively with 25 ml of hexane (volume required depended on humidity and was determined by daily calibration) for fraction I, 10 ml of 25% methylene chloride in hexane for fraction II and 20 ml of methylene chloride for fraction III. Fraction I contained HCB, PCB's, DDE, Heptachlor and aldrin; fraction II contained BHC's, chlordanes, DDD and DDT while fraction III contained heptachlor epoxide, dieldrin, endrin, and endosulphan. Fraction I was concentrated to 1 ml while fractions II and III were evaporated to near dryness and made up to 1 ml with hexane for gas chromatography.

Gas Chromatographic Conditions

Fraction I: Varian 1400 equipped with Ni-63 detector. Column: borosilicate glass; 180 cm x 2 mm I.D. Packing: 3% Dexsil 300 on Chromosorb W. Temperatures: column at 190°C, injector at 210°C, detector at 300°C. Carrier gas: Nitrogen at 30 ml/min.

Fractions II and III: Tracor 222 with Ni-63 detector in DC mode. Column: borosilicate glass, 180 cm x 2 mm I.D. Packing: 11% OV17-QF1 on Gas Chrom Q. Temperatures: column at 210°C, injector at 220°C, detector at 300°C. Carrier gas: Nitrogen at 35/min.

Pesticide quantitation was performed on a peak height basis using calibration curves prepared daily. For PCB's the peak pattern was matched to an Aroclor 1254:1260 mix of suitable proportions, usually a 4:1 mix. The sum of the peak heights with retention times greater than DDE was used for PCB quantitation.

Recoveries

Routine spiking of substrates gave recoveries of 80-94% for PCB's and 75-110% for organochlorine pesticides.

RESULTS AND DISCUSSION

Fish

The importance of the spottail shiner as a forage fish has been well documented (Price 1963; Parsons 1971; Scott and Crossman 1973). In spite of its prominent position in the aquatic food web, comprehensive biological studies from Canadian waters are few. The general abundance and availability of a distinct age group (0+) of this cyprinid enhanced its selection as an indicator species. Since the spottail's home range is generally restricted to a one square mile area (Scott 1975), it is a useful organism for use in localized contamination assessment.

While no direct age determinations were attempted for the fish collected, young-of-the-year individuals were recognizable by their size distributions. The recorded mean total lengths for the first growing season from Lake Erie spottail shiners have been shown to range from 76-78 mm (Carlander 1969; Wells and House 1974). All fish collected from Lake Erie for this study were well below this size, with mean total lengths ranging from 61-65 mm. When allowances are made for the unrealized growth potential during the remainder of the growth season, there is good agreement between the recorded growth statistics for the age group 0+ and size distributions obtained from this study. The mean total length obtained from spottail shiners captured in 1972 off Port Credit in Lake Ontario showed the first year's growth to be about 70 mm (Christie 1975). In comparison the mean total lengths for the young-of-the-year Lake Ontario spottails collected for residue analyses in this study ranged from 52-64 mm. With the exception of fish from Toronto Harbour and Port Credit, all other collections were young-of-the-year individuals. Therefore, for comparisons of relative contamination the above two collection sites were considered separately.

All fish samples from the eleven stations analyzed contained PCB and DDT residues. Heptachlor epoxide was present in all but Frenchman's Bay and Point Pelee samples, while dieldrin, endrin and chlordane were found only in Presquile and Toronto Harbour Collections (Table 1). The o,p'-DDT was found in thirty-three out of a total of fifty-four analyses, whereas p,p'-DDT was found only in one sample. The major fraction of the total DDT complex was p,p'DDE. The mean PCB concentrations for the

young-of-the-year spottails ranged from 0.06 $\mu\text{g/g}$ - 0.84 $\mu\text{g/g}$ on a wet weight, and from 2.9 $\mu\text{g/g}$ - 46.7 $\mu\text{g/g}$ lipid weight, while total DDT residue ranged from 0.03 $\mu\text{g/g}$ - 0.24 $\mu\text{g/g}$ wet weight and from 1.4 $\mu\text{g/g}$ - 10.4 $\mu\text{g/g}$ lipid weight. The mean PCB residue levels obtained from the Toronto Harbour and Port Credit collections were 1.98 $\mu\text{g/g}$ and 3.85 $\mu\text{g/g}$ respectively, with corresponding lipid weight concentrations of 29.1 $\mu\text{g/g}$ and 52.7 $\mu\text{g/g}$. The mean total DDT residues for the Toronto Harbour collections were 0.22 $\mu\text{g/g}$ wet weight and 3.2 $\mu\text{g/g}$ lipid weight, while the Port Credit residue values were 0.47 $\mu\text{g/g}$ and 6.5 $\mu\text{g/g}$ respectively (Table 2).

Of the eleven chemicals analyzed, only PCB residues exceeded the recommended body burden levels established for protection of wildlife (IJC-1975). With the exception of Port Colborne and Port Rowan stations the recommended PCB residue concentrations of 0.1 $\mu\text{g/g}$ (ppm) were exceeded at all sampling locations (Table 1). In spite of the relatively uniform fish size and fat content, regional differences of PCB residue levels in the young-of-the-year spottails were considerable. Fish from the Point Pelee, Niagara-on-the-Lake, Darlington and Presquile samples contained the highest residue concentrations. Elevated PCB residue levels were identified in the young-of-the-year spottails from the industrialized areas of Detroit and Niagara rivers, as well as the Oshawa-Trent complex. In contrast, PCB residue concentrations in fish from the predominantly rural areas of Port Rowan, Port Carling and Glenora were relatively low. All fish samples from the Port Credit, and 40% from the Toronto Harbour collections exceeded the 2 ppm Federal Guideline for PCB residue concentrations in fish for human consumption. The above two collections were composed of spottails of the 2 and 3 year age groups and therefore incomparable with the results of the young-of-the-year collections. However, data obtained from these older forage fishes illustrate the contaminant availability for biological uptake, and suggest the likelihood of unacceptable PCB residue levels in near-shore piscivorous fish species of this region.

Since DDE: Σ DDT ratios from fish residue analyses reflect the relative presence or absence of the major metabolite of DDT degradation, the lower ratios are often associated with recent inputs of the parent

material. However, regional interpretations of the ratios are complicated by variations in environmental conditions, therefore, temporal applications offer the most useful approach in DDT residue trend evaluations. The lower DDE:ΣDDT ratios from this study were obtained from the Port Rowan, Point Pelee and Toronto Harbour collections (Table 3). Due to the special concessions given to Ontario tobacco growers, DDT applications in the tobacco fields were permitted well beyond the Province-wide ban of 1970. Therefore, the proximity and land-use practices of the major tobacco growing areas in Southwestern Ontario could have had an impact on the former two collection sites, resulting in higher parent material content in the aquatic biota. The reasons for the relatively high unmetabolized DDT residues in Toronto Harbour fish are not understood and require further study.

The observed DDT residue trends in Lake Michigan indicate that the ban on DDT use has reduced residue levels in the biota (Hesse 1975). Similar residue reductions have been documented in the Muskoka area lake smelt populations in Ontario, (unpublished data). These observations suggest that similar DDT residue trends can be anticipated in the Lower Great Lakes.

Sediments

With the exception of Port Rowan, Presqu'île, Frenchman's Bay and Tremblay Creek sites, all organic sediment samples contained PCB residues above the detectable levels. Residues of DDT and its metabolites were found in all samples analyzed. The parent materials o,p'-DDT and p,p'-DDT were found in all samples except for the Presqu'île and Darlington collections. Presqu'île sediments contained only o,p'-DDT, while no parent material was detected at the Darlington site. Chlordane was found in all, except the Presqu'île collection. Dieldrin was only present at the Frenchman's Bay and Niagara-on-the-Lake sites, whereas thiodan was detected only at the Niagara site (Table 4).

In order to isolate residue data for sandy sediments, a purely arbitrary division was made by grouping all samples with a 2% loss on ignition and less under the heading of "sand". All other sediment samples with a higher organic content were grouped as "other". PCB residues in the sandy sediments ranged from non-detectable levels to 57 ng/g (ppb), whereas

residues in the more organic sediments ranged from non-detectable to 569 ng/g. Total DDT residues ranged from 2 ng/g - 15 ng/g for the sandy, and 7 ng/g - 88 ng/g for sediments with higher organic content.

Although PCB and total DDT residues for the pooled sample were found to be significantly correlated with the organic content of the sediments tested, ($p < 0.05$) the observed relationship is not valid when individual sampling area results are analyzed. However, it should be noted that PCB and total DDT residues were consistently low in the sandy sediments (Fig. 2). While samples from Port Credit, Toronto Harbour and Darlington collections revealed elevated PCB residue concentrations, identifiable with high levels of industrial activity, no such conclusions could be made from the results of the Niagara-on-the-Lake and Point Pelee samples. It would seem that, in the absence of properly developed sediment characteristics, interpretation of sediment residue data is difficult, particularly when the sample size is small. Data obtained from this study suggest that factors other than sediment characteristics alone govern residue distributions in lake sediments. Considering the wide sediment residue fluctuations, it can be concluded that indiscriminate sediment sampling, without proper definition of sediment characteristics and factors influencing its deposition patterns, has limited value in contaminant residue assessment.

Lake Water

Within the sensitivity range employed (detection limit $0.01 \mu\text{g/l}$), no PCB residues were found in any of the water samples analyzed. Other investigators have reported PCB residues in Lake Ontario water to range from 35 to 77 ng/l (Haile 1975).

In order to detect the low concentrations of PCB's in surface waters, large sample volumes are generally required for residue analyses. Further to handling difficulties, PCB residue level comparisons between samples are complicated by quantitative and qualitative fluctuations in the suspended solids phase of the sample. While recent attempts to separate the dissolved and particulate components of the contaminant residue have contributed towards water sample standardization, the bulk handling problem is still unresolved (Fitzsimons 1976). It should be noted, however, that even suitably standardized water samples will provide residue information for a specific period in time only. Proper identification of seasonal variations in contaminant transport is required for each study area

to assess the contaminant loading and availability for biological uptake.

Rainwater

No PCB residues were found in any of the twelve samples analyzed employing the detection limit of 0.01 µg/l (Table 6). Other rainfall residue investigations in Ontario have reported PCB concentrations ranging from non-detectable to 0.12 ppb levels. Further work on PCB residue quantification in rainfall is being continued by Dr. W. Strachan of C.C.I.W. and Dr. M. Sanderson of the University of Windsor and the Ontario Ministry of the Environment.

While the available rainfall residue data indicate a high variability in contaminant concentrations, the total and continuous absence of any detectable PCB residues in the Ministry of the Environment collections is difficult to rationalize as a regular variance. These results may suggest the absence of significant point-sources in the immediate sampling area.

Industrial Wastes

Final effluents from automotive and the electrical equipment industries contained varying concentrations of PCB residues (Table 7). The automotive parts manufacturer did not knowingly employ any PCB-containing compounds in the process, however, it was admitted that the chemical make-up of the compounds used was generally unknown to the manufacturer. Although quantities of PCB's were commonly used by the electrical equipment manufacturer, specific handling procedures were thought to be observed to control accidental discharges and effect proper disposal of process wastes.

While it is difficult to assess the significance of PCB loading via industrial discharges from the limited data available, this preliminary survey does suggest that industrial sources are still active contributors in the Lower Great Lakes area.

Municipal Sewage Effluent

Effluent samples from twenty-one municipal sewage treatment centres along the Lower Great Lakes were collected during the summer of 1975 (Table 5). Ten out of the twenty-one samples analyzed were found to

contain detectable PCB residues, ranging from 0.03 $\mu\text{g/l}$ to 0.57 $\mu\text{g/l}$. Since the above survey was based on two grab samples only from each locality, it is difficult to estimate absolute values for PCB residue discharged from municipal treatment centres. However, the general range of PCB residue concentrations found in this study is in good agreement with the findings published by Shannon et al 1975. While the residue levels may not appear high in the sewage treatment plant effluent, the volume of treated municipal sewage discharged to the Lower Great Lakes is considerable. Due to the magnitude of discharge and the ability of PCB residues to accumulate in the biota, existing discharge levels may well be real contributors to PCB contamination of fish in nearshore habitats.

Since numerous industries in the Province discharge their effluents to the sewage treatment plants, testing of industrial effluents may be a useful approach in PCB point-source identification and assessment of industrial contributions to PCB loading in sewage treatment plant influent.

CONCLUSIONS AND RECOMMENDATIONS

Due to their widespread distribution and relatively high residue levels in the biota, chlorinated hydrocarbon contaminants in the Lower Great Lakes present a potential hazard to fish, wildlife and man.

The observed DDT residue trends in Lake Michigan and the Muskoka Lakes have shown that the ban on DDT usage has reduced residue levels in the aquatic biota. Similar DDT residue trends can be anticipated in the Lower Great Lakes.

While the general availability of PCB's for open-ended usage has been curtailed by its North American manufacturer, active PCB inputs to the Lower Great Lakes are still evident in the Province. The results of this study show regional differences of PCB residue concentrations in the spottail shiners to be appreciable, with the major problem areas being associated with high levels of industrial activity. As a result, the Toxicity Unit in cooperation with Regional Industrial Abatement personnel have undertaken industrial effluent sampling of suspect industries. Preliminary results have confirmed the presence of industrial discharges of PCB's.

Considering their short-lived exposure to the contaminants, young-of-the-year spottails have proven to be sensitive concentrators of chlorinated hydrocarbons, and may be useful indicators in contaminant residue trend monitoring. While facultative feeding habits of fishes may suggest changes in the predator-prey relationships, there is a possibility that contaminant residue relationships for fishes occupying different trophic levels in the food chain are relatively stable. Development of such relationships between a common forage species (young-of-the-year-spottail) and other fishes from the near-shore habitats may provide a useful tool for fish residue assessment by utilizing the forage fish residue levels as common denominators.

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River and Western Lake Erie.

Table 1: Chlorinated Hydrocarbon Residues in Spottail Shiners - Lakes Ontario, Erie and St. Clair - 1975. (ng/g wet weight)

	Number of Analysis	Mean Fish Length (T.L.) (mm)	% Fat Content	PCB	Σ DDT	Heptachlor Epoxide	Dieldrin	Endrin	Chlordane α	Chlordane γ
Glenora	5	64 $\pm$ 4	2.9 $\pm$ 0.3	111 $\pm$ 27	41 $\pm$ 7	1 $\pm$ 0				
Presqu'île	5	60 $\pm$ 4	2.7 $\pm$ 0.2	520 $\pm$ 91	77 $\pm$ 12	2 $\pm$ 2	1 $\pm$ 2	1 $\pm$ 0		1 $\pm$ 1
Darlington	5	64 $\pm$ 4	4.9 $\pm$ 0.8	420 $\pm$ 116	91 $\pm$ 29	1 $\pm$ 1				
Frenchman's Bay	5	52 $\pm$ 5	2.2 $\pm$ 0.3	200 $\pm$ 35	46 $\pm$ 10					
Toronto Harbour	5	77 $\pm$ 3	6.8 $\pm$ 0.5	1980 $\pm$ 622	221 $\pm$ 79	3 $\pm$ 2	16 $\pm$ 18	3 $\pm$ 4	7 $\pm$ 6	13 $\pm$ 13
Port Credit	5	94 $\pm$ 4	7.3 $\pm$ 0.9	3845 $\pm$ 2247	465 $\pm$ 51	1 $\pm$ 2				
Niagara-on-the-Lake	5	56 $\pm$ 4	2.3 $\pm$ 0.3	690 $\pm$ 195	244 $\pm$ 52	1 $\pm$ 1				
Port Colborne	5	61 $\pm$ 3	1.2 $\pm$ 0.3	82 $\pm$ 29	32 $\pm$ 23	1 $\pm$ 1				
Port Rowan	5	65 $\pm$ 4	2.1 $\pm$ 0.6	59 $\pm$ 29	128 $\pm$ 65	1 $\pm$ 1				
Point Pelee	5	63 $\pm$ 3	1.8 $\pm$ 0.2	844 $\pm$ 403	92 $\pm$ 22					
Tremblay Creek	4	65 $\pm$ 5	3.4 $\pm$ 1.9	275 $\pm$ 207	81 $\pm$ 54	2 $\pm$ 1				

TABLE 2 MEAN CONCENTRATIONS OF PCB'S AND TOTAL DDT IN SPOTTAIL SHINERS,
LAKES ONTARIO, ERIE AND ST. CLAIR - 1975 ($\mu\text{g/g}$)

Location	Number of Analyses	Mean Fish Length mm	S.D.	Lipid Content %	S.D.	PCB's				TOTAL DDT			
						Wet Weight		Lipid		Wet Weight		Lipid	
						Conc.	S.D.	Conc.	S.D.	Conc.	S.D.	Conc.	S.D.
Glenora	5	64	4	2.9	0.3	0.11	0.03	3.8	1.4	0.04	0.01	1.4	0.4
Presqu'île	5	60	4	2.7	0.2	0.52	0.09	19.3	3.5	0.08	0.01	3.0	0.4
Darlington	5	64	4	4.9	0.8	0.42	0.12	8.6	1.1	0.09	0.03	1.8	0.3
Frenchmans Bay	5	52	5	2.2	0.3	0.20	0.04	9.1	1.8	0.05	0.01	2.3	0.6
Toronto Harbour	5	77	3	6.8	0.5	1.98	0.62	29.1	8.0	0.22	0.08	3.2	1.0
Port Credit	5	95	4	7.3	0.9	3.85	2.25	52.7	28.7	0.47	0.05	6.4	1.6
Niagara on the Lake	5	56	4	2.3	0.3	0.69	0.20	30.0	5.4	0.24	0.05	10.4	2.1
Port Colborne	5	61	3	1.2	0.3	0.08	0.03	6.7	2.8	0.03	0.02	2.5	1.8
Port Rowan	5	65	4	2.1	0.6	0.06	0.03	2.9	0.7	0.13	0.07	6.2	2.0
Point Pelee	5	63	3	1.8	0.2	0.84	0.40	46.7	26.4	0.09	0.02	5.0	1.1
Tremblay Creek	4	65	5	3.4	1.9	0.28	0.21	8.2	1.7	0.08	0.05	2.4	0.6

TABLE 3
MEAN ppDDE/ Σ DDT RATIOS FROM SPOTTAIL SHINER RESIDUES
LAKES ONTARIO, ERIE AND ST. CLAIR - 1975

Location	ppDDE/ Σ DDT	
	Ratio	S.D.
Glenora	0.73	0.08
Presqu'île	0.82	0.03
Darlington	0.75	0.10
Frenchmans Bay	0.73	0.11
Toronto Harbour	0.53	0.10
Port Credit	0.79	0.10
Niagara-on-the-Lake	0.77	0.12
Port Colborne	0.84	0.13
Port Rowan	0.51	0.22
Point Pelee	0.59	0.12
Tremblay Creek	0.73	0.08

TABLE 4 MEAN CONCENTRATIONS OF CHLORINATED HYDROCARBONS IN LAKE SEDIMENTS FROM
LAKES ONTARIO, ERIE AND ST. CLAIR - 1975
(ng/g dry sediment)

Location	Number of Analyses	PCB	ΣDDT	Dieldrin	Chlordane α	Chlordane γ	Thiodan I	Thiodan II
GLENORA								
Sand	4	ND	6	ND	ND	ND	ND	ND
Other	2	490	18	ND	1	ND	ND	ND
PRESQUÎLE								
Sand	6	ND	3	ND	ND	ND	ND	ND
Other	0							
DARLINGTON								
Sand	8	12	2	ND	1	1	ND	ND
Other	4	178	10	ND	4	4	ND	ND
FRENCHMANS BAY								
Sand	2	ND	6	3	1	1	ND	ND
Other	10	ND	27	5	2	1	ND	ND
TORONTO HARBOUR								
Sand	5	50	6	ND	1	2	ND	ND
Other	7	569	36	ND	6	7	ND	ND
PORT CREDIT								
Sand	9	7	3	ND	1	2	ND	ND
Other	3	247	52	ND	1	2	ND	ND
NIAGARA ON THE LAKE								
Sand	10	42	5	1	2	2	Trace	9
Other	2	70	88	6	40	6	ND	ND
PORT COLBORNE								
Sand	4	25	3	ND	1	1	ND	ND
Other	8	32	7	ND	2	2	ND	ND
PORT ROWAN								
Sand	1	40	15	ND	ND	ND	ND	ND
Other	5	ND	22	ND	4	3	ND	ND
POINT PELEE								
Sand	7	57	15	ND	3	3	ND	ND
Other	5	79	29	ND	6	7	ND	ND
TREMBLAY CREEK								
Sand	11	ND	2	ND	Trace	Trace	ND	ND
Other	1	ND	10	ND	ND	ND	ND	ND

TABLE 5 PCB'S IN WASTEWATERS FROM SELECTED
ONTARIO MUNICIPALITIES - 1975

Location	Average Flow (MIGD)	*PCB Concentration (ppb)
Cornwall	10.0	0.05
Brockville	3.0	0.09
Kingston	11.9	0.05
Belleville	7.0	ND
Trenton	2.0	0.06
Cobourg	3.0	ND
Oshawa	9.0	ND
Toronto East	180.0	ND
Toronto Humber	63.0	0.57
Clarkson	9.0	ND
Oakville	6.0	0.40
Burlington	8.0	0.30
Hamilton	52.0	0.10
Port Weller	8.5	0.03
St. Catharines	9.0	ND
Port Colborne	1.2	0.10
St. Thomas		ND
Windsor West	24.0	ND
Chatham	4.5	ND
Wallaceburg		ND
Sarnia	7.0	ND

*Concentration represents a mean of two analyses

TABLE 6 PCB'S IN RAINWATER FROM FIVE
SELECTED SITES IN ONTARIO - 1975

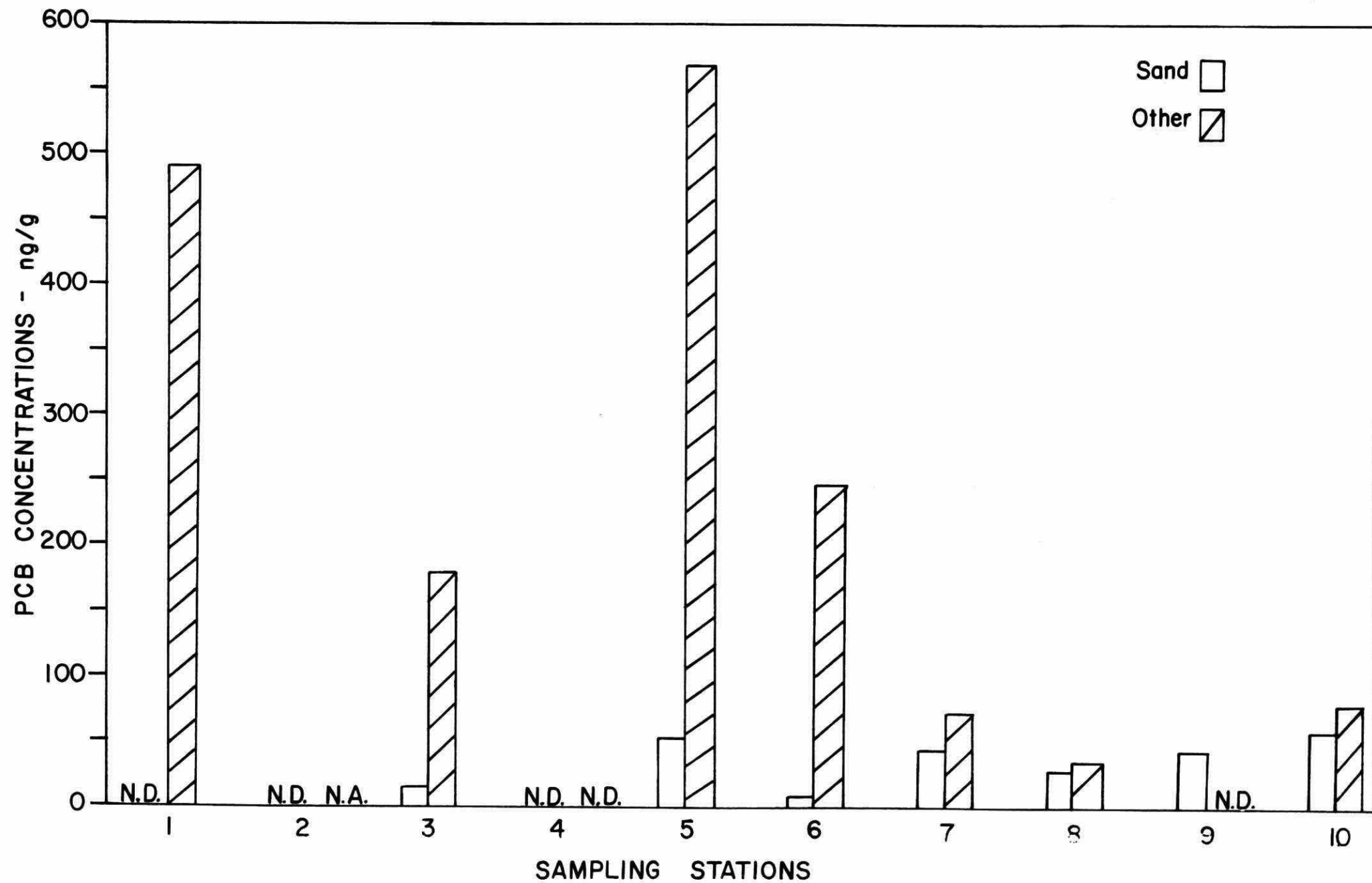
Location	Dates Sampled	PCB Concentrations
Cornwall	Nov. 1	ND
	Nov. 8	ND
Toronto Island Airport	Nov. 11	ND
	Dec. 5	ND
MOE Laboratory Rexdale	Oct. 9	ND
	Oct. 13	ND
	Oct. 19	ND
	Oct. 20	ND
Stoney Creek	Oct. 23	ND
	Nov. 3	ND
	Nov. 10	ND
Jeannetes Creek	Oct. 19	ND

TABLE 7 PCB'S IN SELECTED INDUSTRIAL EFFLUENTS - 1975/76

Location	Company	Date Sampled	Effluent Type	Daily Discharge (Litres)	PCB Conc. (µg/l)	Est. Daily PCB Loading (grams)	Est. Annual* Loading (grams)	Discharged To
St. Catharines	Gen. Motors							
	Plant #1	Nov. 18/75	Cooling Water	4,500,000	2.60	11.70	2,925	Twelve Mile Creek
	Plant #1	Nov. 18/75	Process Water	1,500,000	0.35	0.53	133	Sewage Treatment Plant
	Plant #2	Nov. 18/75	Process Water	109,200,000	0.15	16.38	4,095	Welland Canal
	Plant #2	Feb. 23/76	Process Water		0.20			
St. Catharines	Ferranti Packard	Nov. 18/75	Final Effluent		3.20			
		Nov. 18/75	Final Effluent	514,000	0.90	0.46	115	Sewage Treatment Plant

* Based on 250 working days

Figure 2: Mean PCB Residues in Lake Sediments - Lakes Ontario, Erie and St. Clair.



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